IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

MATHEMATICAL STUDIES
STANDARD LEVEL
PAPER 1

Wednesday 3 November 2004 (afternoon)

1 hour

School code

Candidate code

INSTRUCTIONS TO CANDIDATES

- Write your school code and candidate code in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all the questions in the spaces provided.
- Unless otherwise stated in the question, all numerical answers must be given exactly or to three significant figures.
- Indicate the make and model of your calculator in the appropriate box on your cover sheet.

Maximum marks will be given for correct answers. Where an answer is wrong, some marks may be given for correct method, provided this is shown by written working. Working may be continued below the box, if necessary. Solutions found from a graphic display calculator should be supported by suitable working, e.g. if graphs are used to find a solution, you should sketch these as part of your answer.

1. The total weight of 256 identical pencils is 4.24 kg. Calculate the weight of one pencil, in kg.

   (a) Give your answer exactly.

   (b) Give your answer correct to three significant figures.

   (c) Write your answer to part (b) in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$.

   Working:

   Answers:

   (a) _____

   (b) _____

   (c) _____

2.   The following table gives the postage rates for sending letters from the Netherlands. All prices are given in Euros (€).

Destination	Weight not more than 20 g	Each additional 20 g or part of 20 g
Within the Netherlands (zone 1)	€ 0.40	€ 0.35
Other destinations within Europe (zone 2)	€ 0.55	€ 0.50
Outside Europe (zone 3)	€ 0.80	€ 0.70

(a)   Write down the cost of sending a letter weighing 15 g from the Netherlands to a destination within the Netherlands (zone 1).

(b)   Find the cost of sending a letter weighing 35 g from the Netherlands to a destination in France (zone 2).

(c)   Find the cost of sending a letter weighing 50 g from the Netherlands to a destination in the USA (zone 3).

Working:

Answers:

(a) _____

(b) _____

(c) _____

3. The number of hours that a professional footballer trains each day in the month of June is represented in the following histogram.
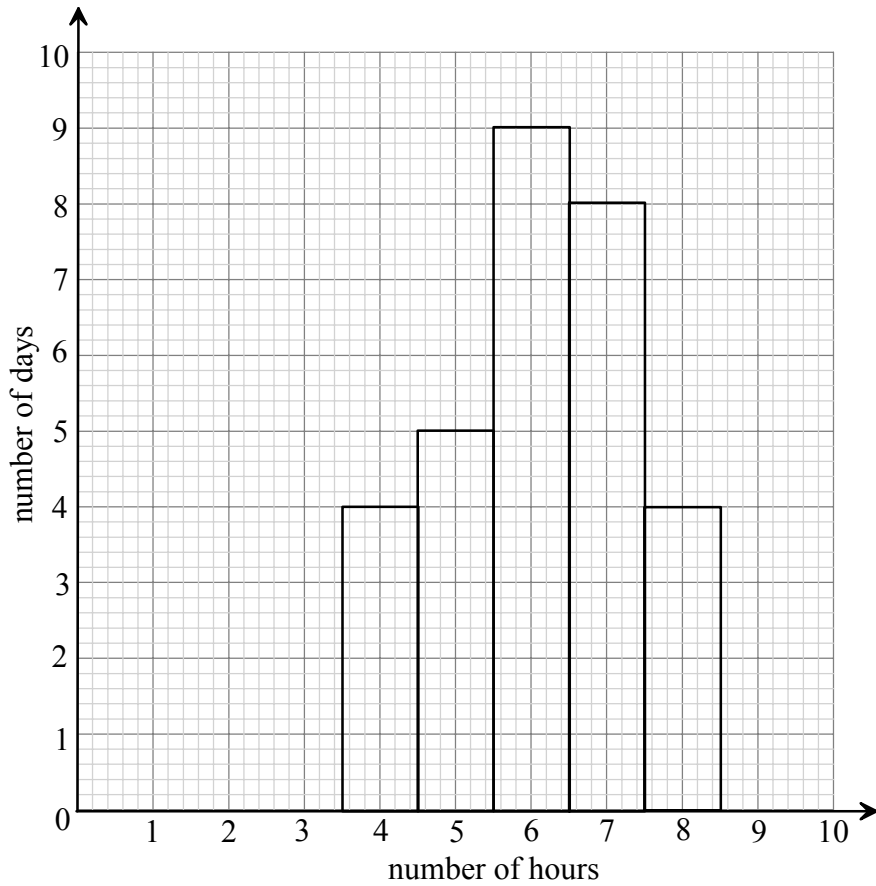
(a) Write down the modal number of hours trained each day.
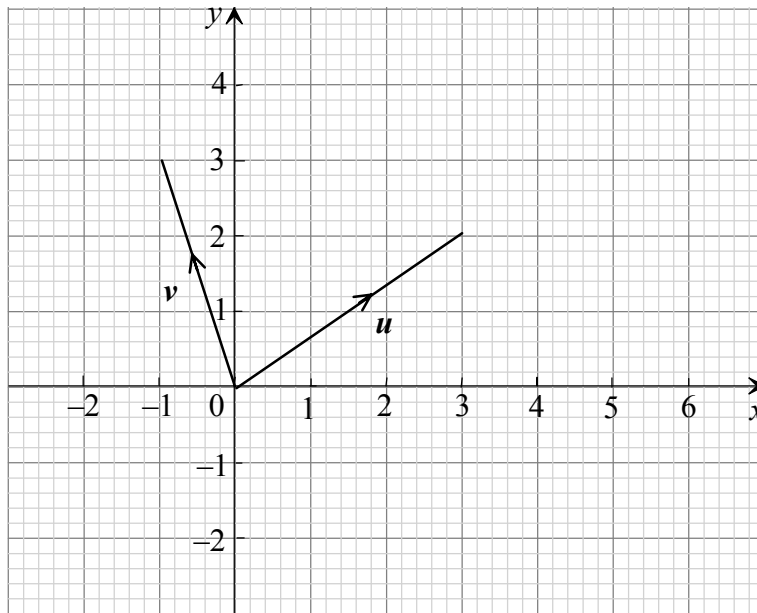
(b) Calculate the mean number of hours he trains each day.

Working:

Answers:

(a) _____

(b) _____

4.   The vectors $\boldsymbol{u}$ and $\boldsymbol{v}$ are shown in the diagram below.

(a)   Express the vectors $\boldsymbol{u}$ and $\boldsymbol{v}$ in the form $\begin{pmatrix} x \\ y \end{pmatrix}$.

(b)   If $\boldsymbol{w} = \boldsymbol{u} - \boldsymbol{v}$, calculate $\boldsymbol{w}$.

(c)   On the grid above, draw and label vector $\boldsymbol{w}$.

Working:

Answers:

(a) $\boldsymbol{u} = \begin{pmatrix} \\ \end{pmatrix}$

        $\boldsymbol{v} = \begin{pmatrix} \\ \end{pmatrix}$
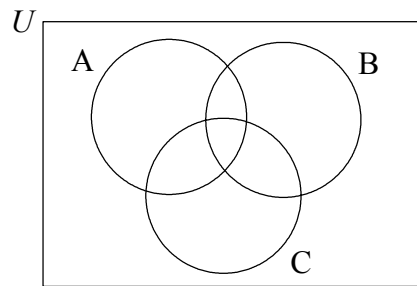
(b) $\boldsymbol{w} = \begin{pmatrix} \\ \end{pmatrix}$

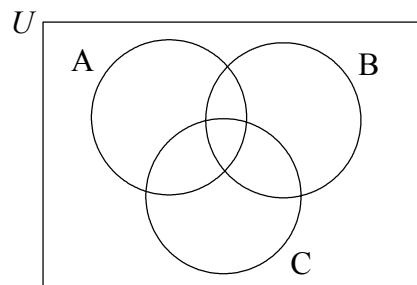**5.** Shade the given region on the corresponding Venn Diagram.
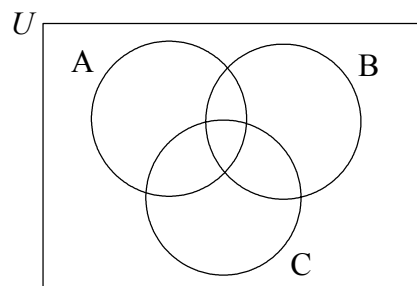
(a) $A \cap B$
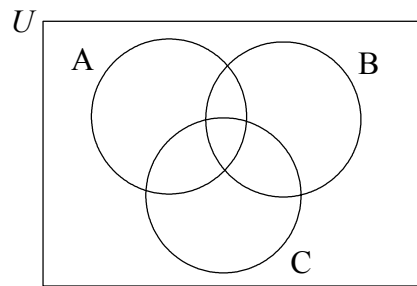
(b) $C \cup B$

(c) $(A \cup B \cup C)'$

(d) $A \cap C'$

6. Consider the following logic statements:

p: the train arrives on time
q: I am late for school

(a) Write the expression $p \Rightarrow \neg q$ as a logic statement.

(b) Write the following statement in logic symbols:
"The train does not arrive on time and I am not late for school."

(c) Complete the following truth table.

p	q	$\neg p$	$\neg q$	$p \Rightarrow \neg q$	$\neg p \wedge \neg q$
T	T	F	F	F	F
T	F	F	T	T	–
F	T	T	F	–	–
F	F	T	T	T	T

(d) Are the two compound propositions $(p \Rightarrow \neg q)$ and $(\neg p \wedge \neg q)$ logically equivalent?

Working:

Answers:

(a) _____

_____

(b) _____

(d) _____

Turn over

7. In 2000 Herman joined a tennis club. The fees were £ 1200 a year. Each year the fees increase by 3 %.

(a) Calculate, **to the nearest £ 1**, the fees in 2002.

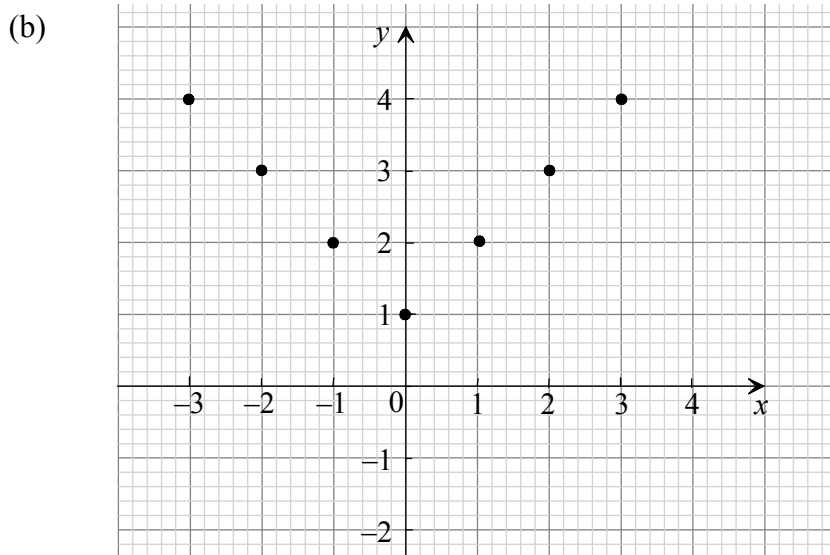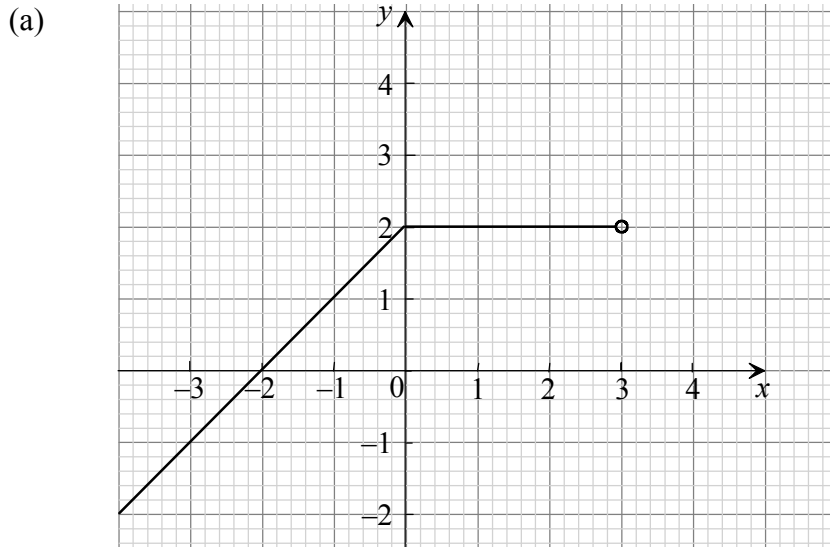(b) Calculate the **total** fees for Herman who joined the tennis club in 2000 and remained a member for five years.

Working:

Answers:

(a) _____

(b) _____

**8.**　　Write down the domain and range of the following functions.

(a)

(b)

Working:

Answers:

(a) _____

　　_____

(b) _____

9.   OABCD is a square based pyramid of side 4 cm as shown in the diagram.
The vertex D is 3 cm directly above X, the centre of square OABC.
M is the mid-point of AB.

(a)   Find the length of XM.

(b)   Calculate the length of DM.

(c)   Calculate the angle between the face ABD and the base OABC.

D

Diagram
not to scale

C

B

X

M

O

A
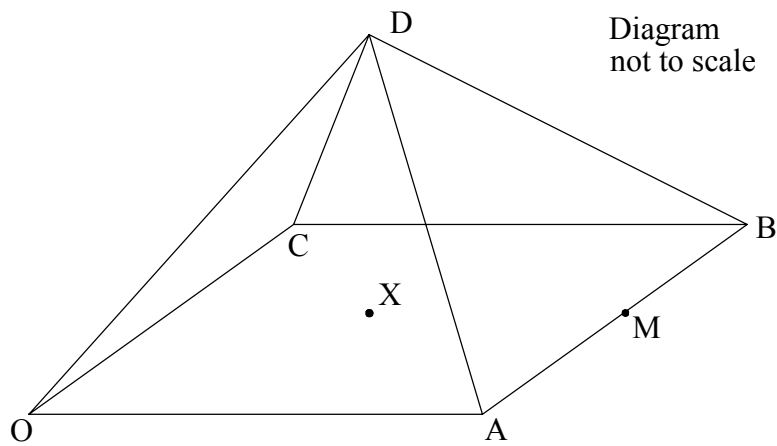
Working:

Answers:

(a) _____

(b) _____

(c) _____

10. The probability, p, that James gets up before 07.00 is 0.95.
If James gets up before 07.00, the probability, t, that he arrives at school on time is 0.98.
If James gets up later than 07.00, the probability that he arrives at school on time is 0.55.
The above information is represented by the following tree diagram.
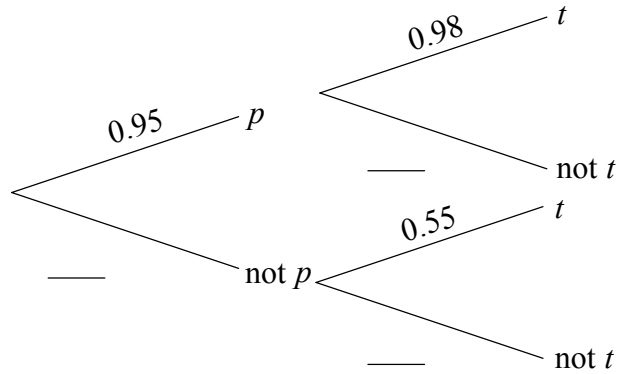
(a) Complete the tree diagram.

(b) Calculate the probability that James gets up before 07.00 and is on time for school.

(c) Calculate the probability that James does **not** arrive at school on time.

Working:

Answers:

(b) _____

(c) _____

Turn over

11. Bobby is spending a year travelling from America to France and Britain.
Consider the following exchange rates.

1 US dollar (USD)   = 0.983 Euros
1 British Pound (GBP) = 1.59   Euros

(a)   Bobby changes 500 USD into Euros.

(i)   Calculate how many Euros he receives.

He spends 328 Euros in France and changes the remainder into GBP.

(ii)   Calculate how many GBP he receives.

While in Britain Bobby decides to put this money in a bank that pays 6 % simple interest per annum, and he gets a part-time job to cover his expenses. Bobby remains in Britain for six months.

(b)   Calculate how much interest he receives for the six months.

Working:

Answers:

(a) (i)_____

(ii)_____

(b)   _____

12. The sixth term of an arithmetic sequence is 24. The common difference is 8.

(a) Calculate the first term of the sequence.

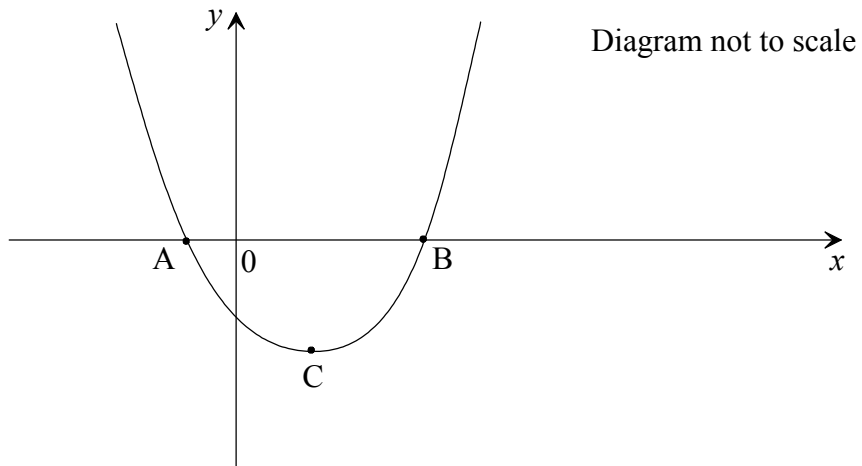The sum of the first n terms is 600.

(b) Calculate the value of n.

Working:

Answers:

(a) _____

(b) _____

Turn over

13. The graph of the function $f(x) = x^2 - 2x - 3$ is shown in the diagram below.
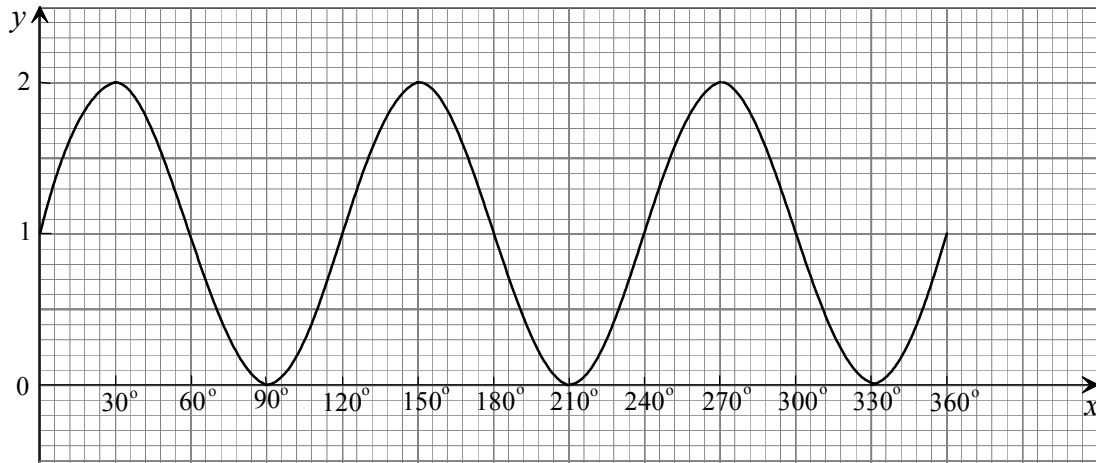
Diagram not to scale

(a) Factorize the expression $x^2 - 2x - 3$.

(b) Write down the coordinates of the points A and B.

(c) Write down the equation of the axis of symmetry.

(d) Write down the coordinates of the point C, the vertex of the parabola.

Working:

Answers:

(a) _____

(b) _____

(c) _____

(d) _____

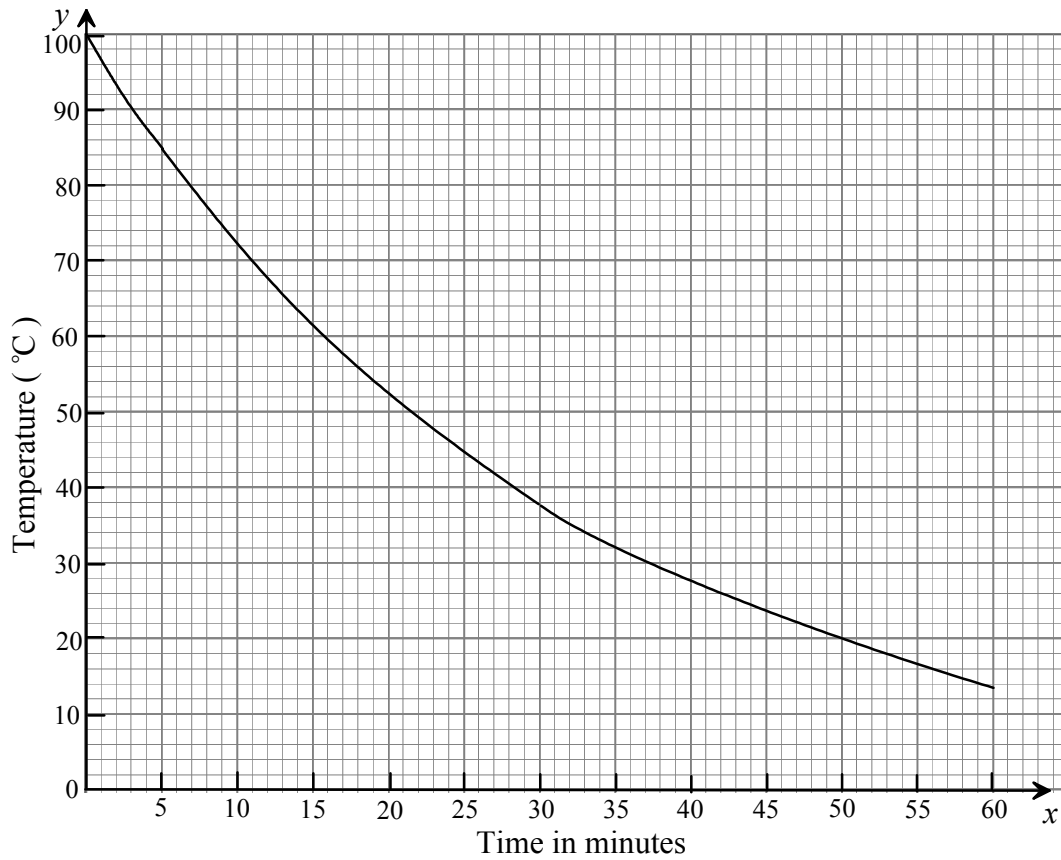**14.** The diagram shows the graph of $y = \sin ax + b$.

(a) Using the graph, write down the following values

(i) the period;

(ii) the amplitude;

(iii) b.

(b) Calculate the value of a.

Working:

Answers:

(a) (i) _____

(ii) _____

(iii) _____

(b) _____

15. The graph below shows the temperature of a liquid as it is cooling.

(a) Write down the temperature after 5 minutes.

(b) After how many minutes is the temperature $50\,°C$?

The equation of the graph for all positive x can be written in the form $y = 100(5^{-0.02x})$.

(c) Calculate the temperature after 80 minutes.

(d) Write down the equation of the asymptote to the curve.

(This question continues on the following page)

(Question 15 continued)

Working:

Answers:

(a) _____

(b) _____

(c) _____

(d) _____